WHAT IS CLAIMED IS:

Sub a2

1. A method of measuring transfer functions of a physical system using a wideband excitation signal comprising the steps of:

a) exciting the system with a low-power, wide band input signal that has a rich frequency content over a wide band; and,

b) using a stochastic process to derive a system transfer function over the excitation signal bandwidth.

2. The method of Claim 1 wherein said input signal is a modulated signal spread over a continuous band.

3. The method of Claim 2 wherein said input signal is frequency modulated.

4. The method of Claim 2 wherein said input signal is amplitude modulated.

5. The method of Claim 2 wherein said input signal is phase modulated.

6. The method of Claim 1 wherein said input signal is an ambient signal.

7. The method of Claim 1 wherein said stochastic process is a non-parametric technique.

Subt. a3

8. The method of Claim 4 wherein said non-parametric technique includes the Welch process.

9. The method of Claim 4 wherein said non-parametric technique includes the Barlette process.

10. The method of Claim 4 wherein said non-parametric technique includes the coherence function.

11. The method of Claim 1 wherein said stochastic process is a parametric technique.

Subt. a4

12. The method of Claim 5 wherein said parametric technique includes adaptive filtering.

13. The method of Claim 5 wherein said parametric technique includes least squares method.

14. The method of Claim 5 wherein said parametric technique includes Pade approximation.

15. The method of Claim 5 wherein said parametric technique includes Prony's method.

16. The method of Claim 5 wherein said parametric technique includes iterative prefiltering.

17. A method of signal transmission and acquisition through a plurality of spatially distributed locations comprising the steps of:

a) locating a data recorder/processor at each distributed location;

b) interconnecting each said data recorder/processor to an acquisition control computer using a telemetry network;

c) sending a frequency synchronization signal through said network;

d) simultaneously receiving signals in said data recorders and storing them at each said location; and,

e) sending recorded signals to said acquisition control computer via said network.

Subt. a5

18. The method in Claim 17 wherein only a single recorder/processor is used.

19. The method in Claim 17 wherein two recorder/processors are used.

20. The method in Claim 17 wherein three or more recorder/processors are used.

21. The method in Claim 17 wherein the said telemetry network uses digital signals.

22. The method in Claim 17 wherein the said telemetry network uses analog signals.

23. The method in Claim 17 wherein the said telemetry network uses fiber optics links.

24. The method in Claim 17 wherein the said telemetry network uses RF or microwave links.

Sub a5 cont'd

25. The method in Claim 17 wherein the said telemetry network uses optical links.

26. The method in Claim 17 wherein the said telemetry network uses hard wire (conducting cable) links.

27. The method in Claim 17 wherein the said telemetry network uses a daisy chain (closed loop) architecture.

28. The method in Claim 17 wherein the said telemetry network uses a star (spokes) architecture.

29. The method in Claim 17 wherein the said telemetry network is selected from the group consisting of digital signals, analog signals, fiber optic links, RF, microwave links, optical links, hard wiring links, daisy chain architecture, star architecture and any combination thereof.

Sub a6

30. The method of Claim 17 wherein said synchronization signal is integrated with the data stream to produce a single signal transmitted through the said network.

Sub a6 con'd

31. The method of Claim 30 wherein the said integration is performed via pulse width modulation.

32. The method of Claim 30 wherein the integration is performed via frequency division multiplexing.

33. The method of Claim 30 wherein the integration is performed via time division multiplexing.

Subt a8

34. The method of Claim 17 wherein said synchronization signal is not integrated with the data stream so that two separate signals are transmitted through the said network.

35. The method of Claim 17 wherein said synchronization signal is transmitted via the methods selected from the group consisting of pulse width modulation, frequency division multiplexing, time division multiplexing, and any combinations thereof.

Subt a8

36. The method of Claim 17 wherein data recorders/processors down-convert the received signal.

37. The method of Claim 17 wherein data recorders/processors store the received signal in digital format.

38. The method of Claim 17 wherein data recorders/processors store the received signal in analog format.

Sub G8 Con'd

39. The method of Claim 17 further including the step of inserting one or more waveform synthesizers in said network.

40. The method of Claim 39 whereas the said waveform synthesizer synthesizes a modulated signal about a specified center frequency.

41. The method of Claim 39 whereas the said modulated signal is fully programmable.

42. The method of Claim 40 whereas the said modulated signal is frequency modulated.

43. The method of Claim 40 whereas the said modulated signal is amplitude modulated.

44. The method of Claim 40 whereas the said modulated signal is phase modulated.

45. The method of Claim 40 whereas the said waveform synthesizer uses up-conversion to shift the modulated signal to the desired center frequency.

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46. A method of estimating the transfer function of a physically distributed system using a low-power/wideband (LPWB) test technique, comprised of the following steps:

a) locating a data recorder/processor at each distributed location;

b) interconnecting each said data recorder/processor to an acquisition control computer using a telemetry network;

c) sending a frequency synchronization signal through said network;

d) simultaneously receiving signals in said data recorders and storing them at each said location;

e) sending recorded signals to said acquisition control computer via said network; and,

f) analyzing said signals using stochastic processing techniques to estimate the system transfer function.

Sub a9

47. The method of Claim 46 whereas the system under test is not physically distributed.

48. The method of Claim 46 whereas the excitation signal consists of ambient radiation.

49. The method of Claim 46 for estimating electromagnetic transfer functions.

50. The method of Claim 46 for estimating acoustic transfer functions.

51. The method of Claim 46 for estimating seismic transfer functions.

52. Apparatus for obtaining data for measuring the transfer function of a physical system comprising:

a) a waveform synthesizer for exciting the physical system with a low-power, wide band input signal that has a rich frequency content over a wide band;

b) a first data recorder/processor for sampling said input signal;

c) second and third data recorder/processors located at spatially distributed locations;

d) digital fiber optic telemetry for digitally interconnecting each said first, second and third data recorder/processors and said waveform synthesizer;

e) an acquisition control computer connected to said first, second and third data recorder/ processors and said waveform synthesizer in a network arrangement;

f) a synchronization signal generator connected to said network; and,

g) a controller means for simultaneously commanding said waveform synthesizer to broadcast said input signal to excite the system and to send a synchronization signal through said network to cause said first data recorder to sample said input signal, to cause said second and third data recorders to measure the signals received from the system in response to said input signal, and to cause said first, second and third recorder/processors to convert the signals received therein to digital format and send said code in synchronized form through said network to said computer for later processing to a transfer function.

53. The apparatus of Claim 52 wherein said waveform synthesizer synthesizes a fully programmable 3 MHz excitation signal about 0-999 MHz center frequency.

54. The method of Claim 53 whereas the synthesized waveform is a pseudo-noise modulated signal.

55. The method of Claim 53 whereas the synthesized waveform is a frequency modulated signal.

56. The method of Claim 53 whereas the synthesized waveform is a amplitude modulated signal.

Sub a9 cont'd

57. The method of Claim 53 whereas the synthesized waveform is a phase modulated signal.

58. The method of Claim 53 whereas the synthesized waveform is a narrowband CW signal.

59. The method of Claim 53 whereas the synthesized waveform has been synthesized using a 12 bit digital to analog converter sampled at 12 MHz.

60. The method of Claim 53 wherein the modulated signal is up-converted to the center frequency of interest.

61. The apparatus of Claim 52 whereas said data recorder/processors can record a 3MHz wide modulated signal centered about any frequency from 0 - 999 MHz.

Subt. a10

62. The apparatus of Claim 52 wherein said data recorder/processors uses a two-step down-conversion techniques for shifting the modulated signal to a 15 MHz center frequency.

63. The apparatus of Claim 54 wherein said data recorder/processors uses a 12 bit analog to digital converters sampled at 12 MHz to digitize and store the modulated signal.

64. The apparatus of Claim 52 wherein said acquisition control computer is capable of running National Instruments' LabVIEW software.

65. The apparatus of Claim 55 whereas said acquisition control computer has a GPIB interface.

66. The apparatus of Claim 55 whereas stochastic process algorithms are coded in LabVIEW.

Subt. a11

67. The apparatus of Claim 52 wherein said telemetry network is a daisy chained digital fiber optics network.

68. The apparatus of Claim 52 wherein an interface control module bridges the digital optics telemetry network with the said computer through a GPIB connection.

Subst a12

69. The apparatus of Claim 52 wherein said frequency synchronization signal generator is a 3 MHz local oscillator located in the interface module.

70. The apparatus of Claim 52 wherein said synchronization signal is transmitted through a fiber optics line with an analog bandwidth of 125MHz.

71. The apparatus of Claim 52 wherein said synchronization signal is integrated with the data stream using pulse width modulation.

add a13

Add CD